

EXPERIMENTAL SAND ANTI-FRACTURE MIXTURE MSP-97-10A

1.0 Description. This specification covers materials and construction requirements for producing and placing a Sand Anti-Fracture (SAF) bituminous mixture to be placed in one course in conformance with the lines, grades, and typical cross sections shown on the plans, or established by the engineer.

1.1 Unless otherwise stated, specification section references are from the version, in effect at the time of this contract, of the Missouri Standard Specifications for Highway Construction and its supplements.

1.2 SAF bituminous mixture is a fine graded highly elastomeric polymer modified asphalt cement mixture. The SAF bituminous mixture shall meet all the requirements for asphaltic concrete in Sec 403, except as modified herein. Delete Sec 403.1 through 403.5 and subsections, Sec 403.8, Sec 403.13.1, Sec 403.18.1 and Sec 403.18.5.

2.0 Materials. All materials shall conform to Division 1000, Materials Details, unless otherwise noted.

2.1 Asphalt Cement. The asphalt cement shall be PG 70-34 meeting Sec 1015 and shall be Styrene-Butadiene (SB) or Styrene-Butadiene Styrene (SBS) polymer modified. In addition, the asphalt cement shall meet the following:

Force Ductility Ratio, ASTM P226	0.8 minimum @ (4 C)
RTFO Elastic Recovery, ASTM D5976-96 Sec 6.2	75% minimum @ (25 C)
Separation Test, ASTM D5976-96 Sec 6.1	(-13 C) difference max. after 48 hr .
Solubility in Trichloroethylene, AASHTO T 44	99.0% minimum

2.2 Blended Aggregate. The blended aggregate shall consist of natural sands, crusher fines and screenings which meet Sec 1002.2.1, except the non-plastic requirement shall not apply. In addition, it shall meet the following.

2.2.1 Gradation. The combined gradation shall meet the following ranges.

Sieve	Percent Passing
3/8 inch (9.5 mm)	100
No. 4 (4.75 mm)	80 - 100
No. 8 (2.36 mm)	60 - 85
No. 16 (1.18 mm)	40 - 65
No. 30 (600 µm)	30 - 55
No. 50 (300 µm)	18 - 32
No. 100 (150 µm)	8 - 18
No. 200 (75 µm)	7 - 14

2.2.2 Natural Sand. No more than 50 percent natural sand by weight shall be used.

2.2.3 Sand Equivalent. The sand equivalent of the total blend shall be a minimum of 70 percent as determined by AASHTO T 176.

2.4 Material Acceptance. All aggregates shall be sampled, tested, and approved by the engineer, prior to use.

3.0 Job Mix Formulas. The contractor shall contact Larry Reddick, Koch Materials Company, 4915 Chelsea, Kansas City, Missouri, 64130-2623, (816) 922-3413, for preparation of the job mix formulas. Koch Materials Company will provide the testing equipment to perform the Force Ductility Ratio testing, the Hveem Stability testing and the Complex Shear Modulus testing, and will provide personnel to conduct the testing in the field lab. Koch Materials Company will provide technical support for production and placement of the SAF mixture.

3.1 The manufacturer of the SAF bituminous mixture shall obtain, in the presence of the engineer, representative samples of asphalt cement and mineral aggregates for tests. The samples of materials shall be of the size specified by the engineer and shall be submitted to the Central Laboratory for testing. The manufacturer shall also develop and submit the job mix formula and present certified test results for the engineer's approval. At least sixty days prior to the manufacturer preparing any of the mixture on the project, the engineer shall have received both the representative samples of the job mix materials and the manufacturer's proposed job mix formula.

3.1.1 No mixture will be accepted for use until the job mix formula for the project is approved by the engineer.

3.1.2 The job mix formula shall be within the master range specified for the SAF bituminous mixture, and shall include the type and sources of all materials, the gradations of the aggregates, the relative quantity of each ingredient, and shall state a definite percentage for each sieve fraction of aggregate and for asphalt cement.

3.1.3 The job mix formula approved for the SAF bituminous mixture shall be in effect until modified in writing by the engineer. When unsatisfactory results or other conditions occur, or should a source of material be changed, a new job mix formula may be requested.

3.2 Proportioning. The engineer will approve the job mix formula and all materials and methods prior to use and will approve the proportions to be used within the following limits.

Asphalt cement, percent	7.5 - 10
Additives	As required

3.3 Mixture Testing Procedures. SAF bituminous mixture shall be tested in accordance with AASHTO Provisional Standard TP 4, Edition 1C, Standard Method for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the SHRP Gyratory Compactor, except as herein noted.

3.4 Compaction Criteria.

3.4.1 The number (N) of gyrations required for gyratory compaction shall be as follows:

	Ndesign	Nmax.
Revolutions	25	50
Voids in the Mineral Aggregate (VMA)	18 - 24	18 - 24
Air Voids (Va), percent	1.5 - 2.5	0.5 - 2.0
Hveem Stability @ 140 F (60 C)	20+	20+
Complex Shear Modulus, psi (MPa), 1 hz, 68 F (20 C)	100 - 150	---

4.0 Construction Requirements.

4.1 Surface preparation. Immediately prior to applying the SAF bituminous mixture, the surface shall be thoroughly cleaned of all vegetation, loose materials, dirt, mud, visible moisture and other objectionable materials, and blown dry with a jet drier as required.

4.2 Weather Limitations. SAF mixtures shall not be placed when either the air temperature or the temperature of the surface on which the SAF mixture is to be placed is below 50 F (10 C).

4.3 Application of Tack. The tack coat shall be applied as set forth in Sec 407 and shall be applied between all layers.

4.4 Gradation Control. In producing SAF mixtures for the project, the plant shall be operated so that no intentional deviations from the job mix formula are made, except as approved by the engineer. The maximum deviation from the approved job mix formula shall be as follows:

Sieve	Maximum Tolerance (Percent Passing by Weight (Mass))
No. 8 (2.36 mm)	± 3.0
No. 200 (75 µm)	± 1.0

4.5 Asphalt Content. The asphalt content shall be within ± 0.5% of the approved job mix formula.

4.6 Spreading and Finishing.

4.6.1 It is recommended that the plant be hot before beginning production of the SAF mixture. The SAF layer shall have an average thickness of 1 inch (25 mm) and shall have a minimum thickness of 5/8 inch (16 mm).

4.6.2 Density. Density of the in-place SAF mixture shall be $98 \pm 1\%$ of the maximum specific gravity as determined by AASHTO T 209. Compaction operations shall start promptly after placement of the SAF mixture. Compaction temperature ranges shall be as provided by the asphalt cement supplier. SAF mixture shall be compacted in pavement deformities greater than 3/4 inch (19 mm) in depth in front of the paver. Deformities larger than 3 inches (75 mm) in depth shall be filled with approved SP125, SP190 or I-C mixture prior to placement of the SAF mixture.

4.6.3 The SAF mixture shall be covered with the binder course within five days after placement.

4.7 Verification specimens of the SAF mixture produced for the project shall be made in accordance with MSP-95-03N "Superpave Asphaltic Concrete Pavement".

4.7.1 The Voids in the Mineral Aggregate (VMA) and Air Voids (Va) shall be within $\pm 1.0\%$ of the approved job mix formula when compacted to N_{design} .

4.8 Test Strip.

4.8.1 This work shall consist of constructing SAF bituminous test strips for each mix design to determine the compactive effort necessary to provide the specified density.

4.8.2 Test strips shall be constructed after approval of a job mix formula and calibration of the SAF bituminous mixing plant. Tack coat shall be applied to the roadbed section followed by the placement of approximately 250 tons (230 Mg) or one hour's production, whichever is less, of approved mix in a single lane within the project limits. The paver and rollers to be used on the project shall be used to put down the test strip. Separate test strips shall be provided for each mix design. Acceptable test strips shall meet density and all other specification requirements for the mixture tested.

4.8.3 Density will be determined in accordance with this specification. Steel wheel rollers in the static mode shall be used for compaction of the mixture. Pneumatic rollers and steel wheel rollers in the vibratory mode shall not be used. If necessary additional test strips shall be constructed until a rolling pattern has been established which will provide the specified density. A new test strip shall also be required whenever a change in the job mix formula occurs, the compaction method or the compaction equipment is changed or unacceptable results occur. Test strips which do not have the specified density shall be removed as directed by the engineer. No additional mix shall be laid until a rolling pattern, acceptable to the engineer, has been established on a test strip.

4.8.4 The materials in test strips approved by the engineer will be paid for at the unit price bid for those materials as provided in the contract. All materials in unacceptable test strips removed by the contractor shall become the property of the contractor and will be disposed of by the contractor at the expense of the contractor.

4.9 Any traffic damaged or marred areas shall be repaired by the contractor at no additional charge.

5.0 Method of Measurement.

5.1 Measurement of SAF bituminous mixture complete in place, including any multiple passes or courses, will be made to the nearest square yard (meter). Measurement of individual passes or courses will not be made. Final measurement of the completed surface will not be made except for authorized changes during construction, or where appreciable errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from the contract quantity.

6.0 Basis of Payment.